

Satellite Executive BRIEFING

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Industry Trends, News Analysis, Market Intelligence and Opportunities

An Industry in Transition

By Elisabeth Tweedie

This year marks the 25th anniversary of the World Satellite Business Week, and drew a record number of attendees. 1,200 to be precise. Had Euroconsult not closed registration the week before the conference started, due to capacity limitations, there may well have been even more. As it was, the 1,200 came from 50 different countries, proving once again, that although satellite may only represent a small part of the overall telecoms market, it is by no means a niche business.

Pacôme Revillon, CEO, Euroconsult, opened the conference as always, but handed over to Nathan de Ruiter, Managing Director, Euroconsult Can-

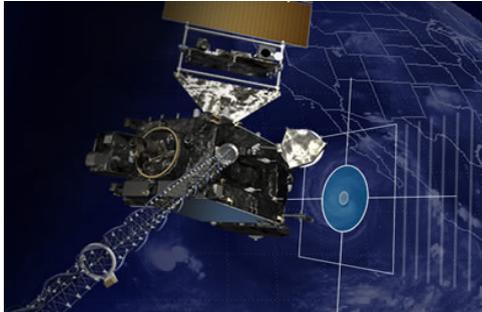
ada, to do the opening presentation, which gave a brief look back over the last 25 years and offered some projections for the next few years, if not 25 years.

In 1997 there were 53 satellites

in orbit, and only a handful of operators. Now we have 53 active operators of geostationary satellites (GEOs), and 2,500 satellites

in non-geostationary orbit (NGSO). Direct-to-home television wasn't launched until 1989, now there are 225 million households around the world watching DTH. As we are all well aware, streaming is taking over from cable and satellite, although DTH

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Industry in Transition



In this issue, we look at the key trends affecting the global satellite industry with our cover story by Elisabeth Tweedie on "An Industry in Transition," which draws on the proceedings of the World Satellite Business Week held in Paris. Over 1,200 participants attended the conference and it could have been a lot more had not the organizers closed registration a week before the event due to capacity limits.

I'm actually cautiously optimistic going forward with the prospects in the global satellite industry. 2022 has so far been more than just a rebound year as industry events have come back live and in-person and business being conducted as close to normal. It's been so good to be back on the trade show circuit, meeting friends face-to-face and conducting live interviews again. It's not quite the same industry and it's constantly evolving, so now more than ever there is the need for accurate and objective reporting and analyses which we are committed to provide.

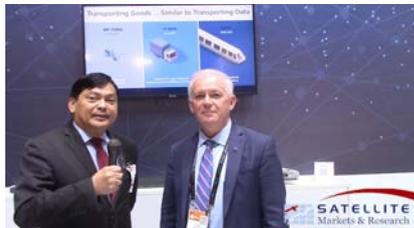
Stay tuned.

Virgil Labrador

Virgil Labrador
Editor-in-Chief

View videos of interviews with key satellite industry executives from IBC 2022 and other trade shows this year at:

www.satellitemarkets.com/satellite-marketcast



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Industry in transition**...from page 1**

remains a growth market in some parts of the world, Africa and Asia Pacific in particular. However, according to de Ruyter, to replace the revenue from one lost US DTH subscriber, an operator would need to sign up 20 DTH subscribers in India. Overall satellite service revenues from video are expected to decline; and by 2031, data, which today only represents 15% of revenues will account for 42% of the US\$124 billion total satcom revenues.

Looking to the near-term future, it seems both repetitive and trite to say that we are an industry in transition. I know I have written that several times in the past. But maybe more than ever it is true today. That's probably why we all love this business, it's constantly changing. The buzz right now is focused on multi-orbit and the associated partnerships and mergers.

Consolidation

Combining two of those topics was the recent announcement from Eutelsat and OneWeb about their plans to merge. Eva Berneke CEO, Eutelsat and Neil Masterson, CEO OneWeb were on stage together in Paris, discussing their plans, which included the second-generation constellation for OneWeb. Berneke pointed out that combining the LEO constellation with Eutelsat's GEO satellites may mean that OneWeb wouldn't need "as many new satellites in order to address peak capacity." Before the announcement, OneWeb's second generation constellation was expected to be larger than the current generation of 648 satellites. Berneke didn't seem

"...Looking to the near-term future, it seems both repetitive and trite to say that we are an industry in transition..."

concerned about the market's negative reaction to the announcement of the merger, saying that it was a big change for Eutelsat's investors, who understood the company and were used to regular dividends. Now they were faced with a new company that they don't really know much about, and the prospect of no dividends for the next three years, so "We need to educate the market." Masterson sees great synergies between the two companies, explaining that as an established player, Eutelsat brings experience, regulatory knowledge and an understanding of satellite markets.

OneWeb on the other hand brings "agility and pace." He was also very enthusiastic about the fact that the combined company would be the only one in the world with a hybrid GEO-LEO constellation. If, Lightspeed from Telesat goes ahead, (and there are unconfirmed rumors that it may not due to supply chain and financing issues), this will no longer be the case.

There was of course, much speculation about a potential merger between Intelsat and SES announced by the Financial Times a few weeks ago. However, whilst neither Steve Collar, CEO SES, nor David Wajsgas, CEO Intelsat would deny outright the rumors, neither would confirm them either.

The other big industry merger and acquisition, that of Inmarsat by Viasat,

earned the two companies the Excellence in Satellite Communications Award, for the strategic transaction of the year. That merger has just received UK regulatory approval.

Other recipients of Excellence in Satellite Communications Awards, were: Starlink, for the Global Satcom Business Award, for its rapid deployment of its constellation. Hispasat, for the Regional Space Business Award, and the Comisión Federal de Electricidad (CFE) Telecomunicaciones e Internet para Todos, for the Universal Connectivity Award. This is an initiative supported by Hughes, Stargroup, APCO Networks, Eutelsat, Axess Networks and Globalsat, to help bridge the digital divide by connecting over 7,200 WiFi and internet community access sites in Mexico.

Industry Forecasts

Euroconsult is forecasting that satellite capacity will grow to more than 97 terabytes per second in the next five years, with 94% of this growth coming from the non-geostationary constellations (NGSOs). Given this extraordinary figure, it is hardly surprising to find a growing interest in being able to offer multi-orbit services. How else will today's GEO operators remain relevant? Until recently, Starlink has been pursuing a one-stop shop direct to the consumer model. Now,

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This year's World Satellite Business Week held in Paris, France attracted over 1,200 participants..

it is moving into the enterprise market and as Jonathan Hofeller, VP Starlink Commercial Sales, said “We are exploring the opportunity to work with partners around the globe. Between now and the end of the year, that is something that I am personally trying to drive.” One of the operators that in discussions with Starlink is KT SAT, which according to David Kyungmin Song, KT SAT’s CEO plans to diversify so as to be able to offer both LEO and MEO options to its broadband customers. Turksat and Arabsat also confirmed that they were in discussions with LEO operators, but did not specify which ones.

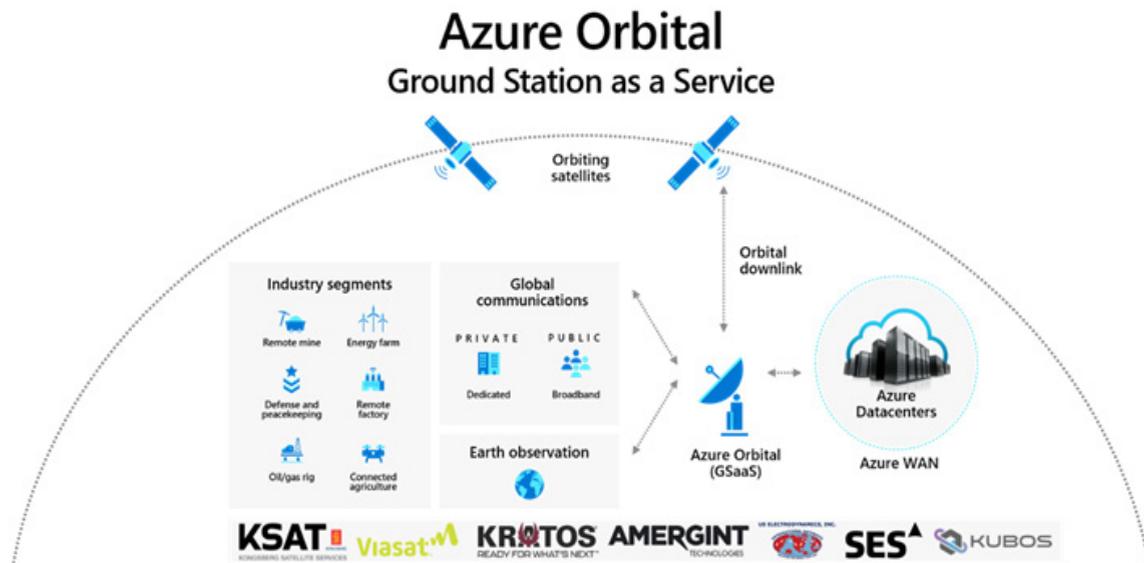
Innovations

Being able to offer multi-orbit service, requires more than signing

an agreement with a NGSO operator. It requires major innovation in the ground segment, so as to provide operators the ability to switch seamlessly between orbits. In a session entitled: “New Digital Dawn for the Ground Segment Business” representatives from ST Engineering iDirect, Kratos, Spacebridge, CPI, Comtech and Hughes were unanimous in the need for flexibility, virtualization and standardization. The latter referring to adhering to telco standards, so as to be easily interoperable. One of the key drivers behind the aim of interoperability, is the hope that by incorporating LEOs into the service offering, satellite can finally overcome one of the main objections of terrestrial operators; namely that of latency, and be regarded as viable part of the telco offering, rather than the technol-

ogy of last resort.

At the end of last year ST Engineering iDirect announced it was entering into a strategic partnership with Microsoft Azure to drive the adoption of virtualization and cloud to enable the digital transformation of the ground segment. During World Satellite Business Week, Frederik Simoens, CTO ST Engineering iDirect and Steve Kitay, Senior Director Microsoft Azure Space in a discussion with CNBC shared more information about the partnership and the progress that has been made. Simoens explained that in the past the company had been forced to focus on things other than their core expertise, such as building hardware and appliances. By virtualizing the modem and moving it to the cloud, “it allows us to focus our expertise on making technology that



makes communication over satellite as efficient as possible, as flexible as possible, and with as high-throughput as possible. This expertise is what really differentiates us, so this is a game changer.” Not only is it a game changer for ST Engineering iDirect, it is also a game changer for customers, particularly for new entrants into the market. With a hardware-based model, a large capital outlay was needed initially, regardless of whether the number of users and volume of traffic justified the investment. This cloudification of the modem technology, changes the customers’ investment from capex to opex, or a “pay-as-you-grow” model.

From Microsoft Azure’s side, Kitay explained that the organization is all about bringing cloud computing and space technologies together with a partner ecosystem. Currently, Azure Space has four ground stations, but will soon have 15. Partners include Viasat, KSat, Airbus, Kratos, SES, SpaceX, and Thales among others. Azure Orbital is essentially offering “Ground Station as a Service.” Kitay

sees Azure’s role is “to make space more accessible, the democratization of space.” He pointed out that this is very early days in the transformation. NGSO satellites make capacity available wherever it is needed, so it is beneficial to effectively have the ground station in the cloud, so you can access it, wherever it is needed.

The industry has made a lot of progress in the last 25 years. Doubtless much more will be made in the next 25, de Ruiter speculated about provision of communications for the lunar economy. Personally, I’m more intrigued by where we will be in the next year or two!

Microsoft's Azure Space has partnered with companies such as Viasat, KSat, Airbus, Kratos, SES, SpaceX, and Thales among others, to provide "Ground Station as a Service."



Elisabeth Tweedie has over 20 years experience at the cutting edge of new communications entertainment technologies. She is the founder and President of Definitive Direction (www.definitivedirection.com), a consultancy that focuses on researching and evaluating the long-term potential for new ventures, initiating their development, and identifying and developing appropriate alliances. During her 10 years at Hughes Electronics, she worked on every acquisition and new business that the company considered during her time there. She can be reached at etweedie@definitivedirection.com

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Why Satellite Needs to Move to a Cloud-based Infrastructure

by Paul Isaac

The global satellite industry is growing at a remarkable pace, most notably in Low Earth Orbit (LEO). According to a recent report by the Satellite Industry Association (SIA), there were, at the end of 2021, 4,852 satellites in-orbit around the Earth, an increase of 179% over 5 years.

Couple that with an increase in flexible and higher capacity payloads the increase in satellite bandwidth is growing exponentially.

While there has been a lot of innovation in satellite technology in recent years, the ground segment has, in contrast, remained relatively unchanged over decades. The industry clearly

needs to modernise and improve the ground segment, so that modern satellite technology such as those high dynamic payloads and new orbit planes, can be truly utilised.

Cloud based technology, with its many benefits seems the obvious solution. Given the numerous advantages that it brings, such as being highly scalable, resilient, flexible, and efficient it is little wonder that broadcast, media and communications businesses are increasingly switching to the cloud.

As cloud-based technology revolutionises connectivity and communications, we're starting to see major cloud providers such as Amazon Web Service's and Microsoft's Azure Orbital Ground Station as a Service offerings start to disrupt the satellite industry's normal mode of operation. In this fast-changing landscape, can satellite operators afford not to virtualise teleports and move ground infrastructure to cloud infrastructure?

Clear Benefits for the Industry

Cloud working brings significant cost savings, primarily because capital expenditure can be significantly reduced but also because of lower ongoing operational costs. This is because services in the cloud tend to run on an on-demand, pay as you go

basis so businesses only pay for what they need. Being in a position to provide a competitive, cost-effective and resilient service is critical for satellite operators, particularly in the changing telecommunications market where IP is transforming the landscape. Cloud based solutions provide satellite operators with a means to shift away from the traditional capex ground segment model, to a more flexible and open model.

Alongside being extremely cost effective, cloud adoption



makes it quick and easy to work flexibly and scale effectively as business needs require. In a world where being able to work in a responsive and dynamic way is critical for business continuity and success, satellite operators need to ensure that business models can meet the needs of their customers by offering a flexible service.

Cloud computing offers opportunities for the monitoring tools to evolve and allow for efficient, streamlined working. Along with being interoperable, cloud tools can be configured and monitored remotely, which makes for incredibly efficient operations. In addition, intelligent management and analytics tools, leveraging AI and machine learning, make it possible to largely automate the process of monitoring and managing service level agreements. In order for satellite operators to scale networks effectively, effective automation is critical, and cloud computing enables that level of automation.

Despite the well documented benefits of the cloud, the satellite industry, as a whole, has not adopted cloud infrastructure at the same rate as other technology sectors. There is perhaps one exception to this and that is with the Earth Observation (EO) segment.

Big Data Management

The management of big data for Earth observation has been made possible by powerful cloud technology. Typical EO datasets are so huge they require cloud infrastructure and tools to store, process and analyse the data. According to a recent report, the EO market is undergoing a period of significant growth and is forecast to reach \$15,903 million by 2032. This growth is being driven by the demand for applications and insights around accurate weather forecasting, sustainable and environment management and disaster management and mapping. Cloud working has clearly allowed EO to develop in ways that it would have struggled to do otherwise, and this has been particularly important for LEO.

Unlocking new opportunities

As we've seen with EO, adopting cloud infrastructure can create real opportunities for development in the satellite industry. In a world where new technology is rapidly changing the communications industry, cloud computing could well be the lever that helps the satellite operators integrate into the 5G world of tomorrow. Generally, users don't care

how data gets to them, whether cellular, fibre or satellite. They just want the data to reach them and be reliable and high quality. It's becoming increasingly clear that rather than being mutually exclusive, satellite and IP can be used together to build stronger, more robust networks. Satellite can provide connectivity where IP cannot and by utilising satellite links for use within 5G communication systems, satellite and telecommunications operators can ensure the best possible outcome for customers. Moving operations to the cloud is important because it will help ensure satellite ground systems are interoperable, so easy for IP networks to integrate with.

Moving ground-based infrastructure to the cloud will also make it easier for new business start-ups to enter the industry. This is because the opex model that cloud computing naturally follows is easier for new ventures to access than a traditional capex model.

Cloud computing presents opportunities not just to new business, but also to existing satellite operators. The interoperability of cloud systems will make it easier than ever before for existing satellite operators to expand their operations by integrating with broader ecosystems.

Resilient Operations

Satellite and network operators are always looking to improve the availability of the services they offer. Moving ground infrastructure to cloud compute allows services to be dynamically re-routed to digital ready gateways to offer site diversity mitigating issues like weather or other factors impacting a gateway's services.

Challenges of moving to the cloud

Naturally, changing the dynamics of something that has existed in a relatively static state for decades is always going to be a challenge. While a challenge, it is not insurmountable and definitely does not outweigh the benefits of using cloud infrastructure.

While many of the functions of the ground segment can be moved to the cloud, there are some components that can't be virtualized, such as antennas, amplifiers, and frequency converters. Thanks to new open standards like that proposed by the Digital Intermediate Frequency Operability (DIFI) consortium, there is a mature basis for converting RF to digital and allowing direct connection to the cloud infrastructure. This enables the transition of core



ground station infrastructure to migrate to the cloud and leverage all the benefits.

There remains a concern about potential cyber security risks that arise from using cloud-based infrastructure. This is particularly true with high security organisations involved with the military and defence but, is also a concern for the broadcast industry when it comes to high value content. Cyber security has to be a key consideration when it comes to any kind of network, regardless of whether cloud based or not. It is worth remembering that the cloud security tools available to operators are extremely powerful and robust and are generally more secure than non-cloud ‘physical’ systems that often lag behind in security patches and updates due to their physical distribution.

Futureproofing the Industry

By adopting a cloud-based infrastructure, satellite operators can align more closely with their customer’s ways of working, provide a better service, and ensure that their businesses remain relevant and competitive. Virtualising the ground segment will increase overall operational efficiency, and improve teleports, making them more cost effective and flexible. If the question is, can the satellite industry afford not to embrace the cloud, then I would say the answer is no, because without switching operations to the cloud, operators will struggle to remain competitive.

The big question is, how do we get there? As an industry we’re undoubtedly going to face new technologies, new challenges, and new opportunities, as satel-

"...Satellite and network operators are always looking to improve the availability of the services they offer. Moving ground infrastructure to cloud compute allows services to be dynamically re-routed to digital ready gateways to offer site diversity mitigating issues like weather or other factors impacting a gateway’s services.."

lite communication transitions to new satellite payloads, constellations and digital gateways. This is why it’s more important than ever that we share our understanding and learning about the key cloud technologies that impact the industry, with each other. It’s not clear right now, quite how the future will shape up in terms of satellite and the cloud but one thing that is certain is this: the cloud is going to revolutionise the satellite industry. 



Paul Isaac is a director of the SIG trade association, and Director of RF products for Kratos’ Space, Training and Cybersecurity Division.

Burnt Toast

By Lou Zacharilla

True story:

I was buttering my toast when it plunged into my gut like knife. I will be dead in 12 minutes.

Later that day I was talking baseball with a doorman on East 69th Street who I have known for 20 years when it occurred to me again. We could die in a horrible incinerating flash in 12 minutes. I kept talking about whether the Yankees would keep Aaron Judge anyway but that thought was there, thanks to Putin and North Korea and every country that has atomic weapons.

Death is a certainty in this life.

The death of Optimism is not so certain. That is the good news.

Yet the trauma somewhere in the back of every human hard drive, that extinction from a nuclear exchange can occur quickly, alters us. We push it to the recess but no one has a central nervous system steely enough to live sanely in a world where this threat is so imminent.

Can it be used to help us focus on the beauty of the moment? I suppose. But that is a mental rationalization and even Tik Tok mumbo-jumbo. There are other ways to live in the moment. But that is a topic for another column.

It takes 11 minutes for a submarine to launch a nuclear warhead and

for it to strike Manhattan – or Moscow, or Beijing or London. Satellites play their role on both sides of this dark equation, but primarily in the “Better Satellite World” they monitor compliance treaties and regimes and try to spot rogues who somehow think ultimate human destruction is central to a sound foreign and domestic policy.

My fearfulness over burnt toast has not stopped this industry from investing in our collective future and using satellites and space to prepare the way.



In this regard, the fate of humanity may rest in our ability to build, launch and manage the next home.

This is being made clear during my conversations with Virgin Orbit, Momentus Space, Space Cornwall and others as part of a new “Opening the Final Frontier” series <https://www.sspi.org/cpages/opening-the-fi->

[nal-frontier-podcast](#) The level and pace at which infrastructure is being assembled for this great journey resembles the period 100 years or so after Europeans first sailed to the “New World.” Our technical prowess is giving way to the two things that seem to matter most to humans: survival and profit.

When gauged accordingly to our imagination and urge to do the right thing ethically, it is the stuff of great adventure. A reawakening.

This was beautifully reminded to me in, of all places, the 10th floor of SAKS Fifth Avenue’s SaksWorks Avenue on November 10th when I had the great honor of moderating an event attended His Royal Highness the Crown Prince of Luxembourg, Franz Fayot, the Luxembourg Minister of the Economy and the Luxembourg Space Agency leadership which centered on the levels of investment pouring into this tiny space-faring nation in Europe. Orbital Ventures Mike Collett, whose space fund is its FIRST sector specific fund and other brilliant investment minds like Will

Porteous and Jonathan Baliff of Redwire were part of a human orchestra I was allowed to conduct to determine whether space is a “thing” now.

It sure is. And it is a significant part of national economies’ futures. That is not me saying it and hoping for it as the cheerleader for SSPI, but it is part of Luxembourg’s national



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economic strategy and, looking at the strategy's ability to attract dollars and euros, a fact.

Earth may end up as an episode of "The Twilight Zone." Perhaps this is the shadow cast by Original Sin, or our species' primal infancy or maybe it is because we just get pissed off too much and some day it is going to catch up to us. I do not know.

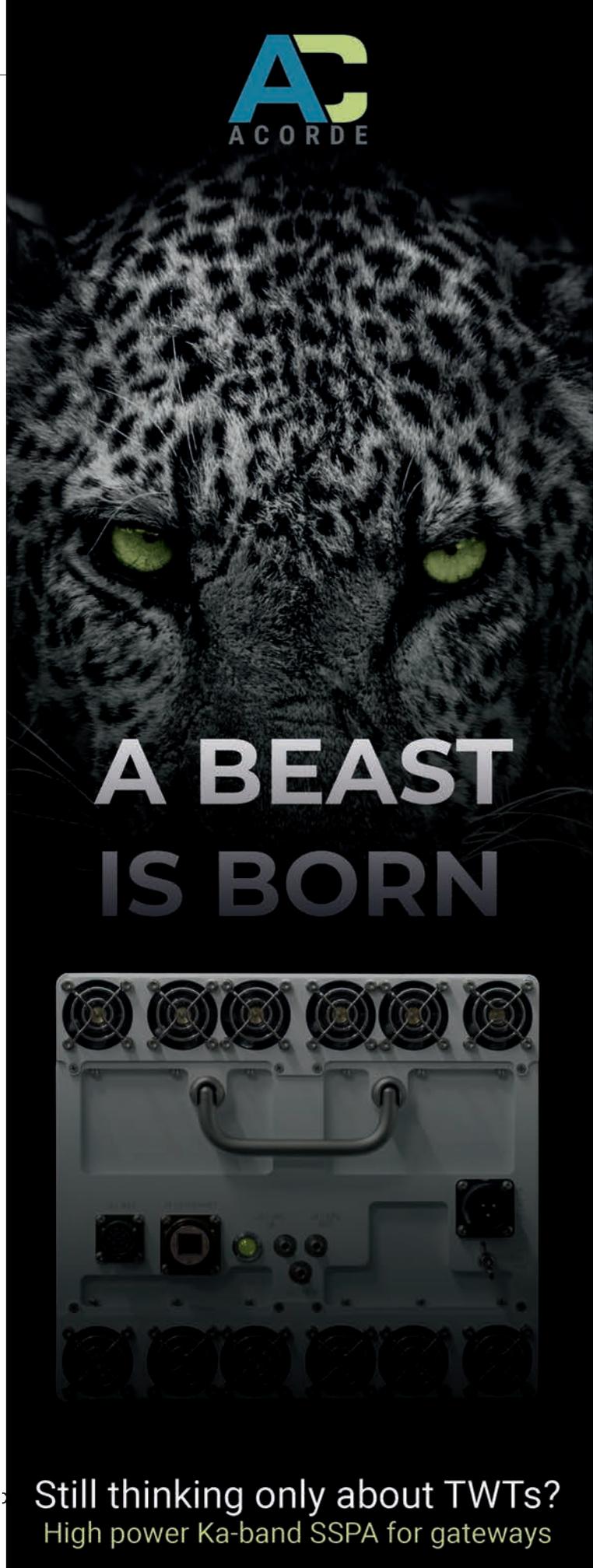
But my takeaway from what I have been a part of lately for the industry leads me to Vaclav Havel's thinking on the word "Hope."

"Hope is definitely not the same thing as optimism. It is not the conviction that something will turn out well, but the certainty that something makes sense regardless of how it turns out." 



Lou Zacharilla is the Director of Innovation and Development of the Space and Satellite Professionals International (SSPI). He can be reached at:

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Virtual Ground Stations

WORK Microwave, a leading manufacturer of advanced satellite communications equipment based in Germany, is introducing an innovative new cloud-based solution called Virtual Ground Stations. As the name indicates, virtual ground stations will require less hardware and therefore less capex costs. "It's economically essential for missions such as Earth Observation, to download data when and where they need it, and paying only for the antenna time they actually use," said Jorg Rockstroh, Director of Business Development and Digital Products for WORK Microwave.

"Controlling satellite communications, Processing data and scaling operations if required remotely, all of this becomes possible with our Virtual Ground Station (VGS) solution. With our V-Series Software Modem and our Digital Converters DBDC & DBUC, you have an all in one VGS

solution," added Rockstroh.

The Digital Converters as antenna subsystems, and the cloud-based Software Modem signal processing system can be installed in different locations or even overseas. Additionally, also the operations can be managed anywhere in the world.

WORK Microwave's Virtual Ground Station (VGS) solution is a state-of-the-art ground station architecture based on digitalized RF signals over IP in accordance with the DIFI standard and wideband signal processing on a cloud platform by a virtualized software modem. VGS brings high flexibility, scalability, efficiency, and "switchability" to ground segment operations by using IP networks that allow flexible composition of the antenna, processing, and operations sides. By supporting as-a-service business models, including ground-station-as-a-service and software-as-a-service, VGS enables operators to pay per use and



VIRTUAL GROUND STATION

reduce their hardware investments. Additionally, VGS allows access from anywhere to any digitized antenna worldwide for satellite and space communication.

WORK Microwave's VGS solution includes:

- V-Series software modems for waveform-based processing and connection to DIFI-compliant IP network subscribers. V-Series software can run completely in the cloud or on-premises at

physical satellite ground stations based on operators' requirements.

- Stand-alone Digitizer/SDR modules with multi-GHz bandwidths are a key element in supporting the migration of ground infrastructures into the digital domain. Satcom-specific designs allow integration into the signal chain with selectable levels of access, for operators, integrators, engineers, and programmers.
- DBUC/DBDC Digital Block up/downconverter, a converter with integrated digitizer which provides signal IP connectivity that seamlessly connects to WORK Microwave's V-Series software modem thanks to DIFI standard compliance, requiring less space, investment, hardware maintenance and cost.

"With our V-Series Software Modem and our Digital Converters DBDC & DBUC, you have an all in one VGS solution. The Digital Converters as antenna subsystems, and the cloud-based Software Modem signal processing system can be installed in different locations or even overseas. Additionally, also the operations can be managed anywhere in the world," said Rockstroh.

In line with its commitment to the digitalization of the satellite ground segment, WORK Microwave, has joined the Digital IF Interoperability (DIFI) Consortium, an independent space-industry group that formed to advance interoperability in satellite and ground-system networks. As a new member of DIFI Consortium, WORK Microwave joins a growing roster of leading organizations in the space industry committed to

"...With our V-Series Software Modem and our Digital Converters DBDC & DBUC, you have an all in one VGS solution. The Digital Converters as antenna subsystems, and the cloud-based Software Modem signal processing system can be installed in different locations or even overseas. Additionally, also the operations can be managed anywhere in the world..."

bringing innovation to the digital transformation of space, satellite, and related technologies.

"With the new space boom and LEO constellations emerging, digitization of the ground segment plays a key role in scalability and sustainability," said Thomas Frölich, CEO of WORK Microwave. "Being a prime supplier of satellite communications equipment, WORK Microwave actively supports standardization and other industrywide efforts to simplify the ecosystem. Joining the DIFI Consortium is an excellent opportunity to help shape the future digitization of the satellite communication ground segment," Frölich added.

WORK Microwave is an early adopter of new technologies, including digital signal processing, modem infrastructures, optical communication, and Q-/V-band equipment. As a long-term contributor to industry standardization, the company has a history of helping advance satellite communication ground technology.



WORK Microwave's DBUC/DBDC digital up/downconverter has signal IP connectivity to seamlessly connect to its V-Series software modem for virtual operation.

"The DIFI Consortium's goal is to provide a simple, open, interoperable digital IF/RF standard that replaces the natural interoperability of analog IF signals and helps prevent vendor lock-in," said Stuart Daughtridge, chair of DIFI Consortium. "We welcome WORK Microwave to the group and look forward to seeing how they will contribute to moving interoperability forward across space networks." 



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Event Parallels: Satellite's Online and In-Person Calendar

by **Martin Jarrold**

As my GVF travel agenda continues to pick-up following the Covid-19 pandemic I'm looking forward to a few days in Bremen, Germany in mid-November, during which I will be moderating two panel sessions at Space Tech Expo Europe 2022. As such in-person events as this return to the calendar following the, thankfully now passed, restrictions of lock-down, the GVF-Connectivity Business News (CBN) Webinar Series also goes from strength to strength. After some 47 events across two-and-a-half years, the Series has most recently included two inter-related themes: 'NewSpace: Will the Bubble Burst?' and 'Space Sustainability: Is it Too Late?'

The first space Special Purpose Acquisition Company began trading three years ago on the New York Stock Exchange. The subsequent rapid rise of the space SPAC was the thematic starting point of the 'NewSpace: Will the Bubble Burst?' focus on examining the risks and returns of NewSpace; it having attracted many millions of dollars of investment based on the belief that start-ups in the segment would ultimately generate profit. With moderator-led questioning from Dara Panahy, Partner, Milbank LLP, the panelists – Mike Collett, Founder & Managing Partner, Promus Ventures; Rob Scheige, Senior Vice President, Willis Towers Watson; and Noel Rimalovski, Managing Director, GH Partners LLC – analyzed where these SPACs are now, and considered the extent to which the taste for them has "bottomed out". Discussion then examined ongoing strategic consolidation across the space and satellite industry, and the extent to which it is likely to be increasingly evident in NewSpace as well as in the more traditional satellite company arena.

Turning from the satellite industry's on-orbit assets to the less-often focused Earth stations, the panelists commented on the question, "What kind of innovation is needed for the ground segment to stimulate investments and drive growth?", concluding with the over-

all view that the ground segment needs more accelerated innovation. (See the recording of this webinar at <https://gvf.org/webinar/new-space-will-the-bubble-burst/>.)



The NewSpace era has seen the emergence of widely-held and deep-rooted concerns about just how unsustainable is the filling of low Earth orbit with our space junk – existing and potential future debris. Space sustainability has now attained top position on the satellite industry agenda and increasingly it is a key topic for governments and international organizations such as the UN and ITU. Surging space activity and an ever-increasing number of objects in orbit has elevated concern about increased risk of collisions and the need to mitigate that risk.

The management of space objects is addressed by the United Nations Office for Outer Space Affairs (UNOOSA) which works to help countries access and leverage the benefits of space to accelerate sustainable development while advancing understanding of the fundamentals of international space law, and increasing capacity to draft or revise national space law and policy in line with international normative frameworks on space – particularly important as more and more actors enter the space arena. UNOOSA works not only to promote sustainable development through space but also to ensure the sustainability of outer space activities, fostering international solutions to problems to preserve space for future generations. Supporting transparency in space activities includes measures such as maintaining the Registry of Objects Launched in Outer Space, which links each object to its responsible country.

In September this year ITU presented a paper at

the 73rd International Astronautical Congress in Paris which mapped the roles and interactions of the main stakeholders in the global space sustainability ecosystem, within which ITU plays a crucial role. Of course, ITU is the UN agency responsible for managing the radio frequency spectrum and associated satellite orbits, together with the treaty-making World Radiocommunication Conference (WRC), and the binding intergovernmental treaty of the Radio Regulations, as updated at the quadrennial WRCs.

As well as being the treaty's managing body, the ITU administers the 'Master International Frequency Register', which provides internationally recognized frequency assignments, and other tools for ensuring the sustainability of space radiocommunication services, such as the online 'Satellite Interference Reporting and Resolution System' (SIRRS) which helps space stakeholders report cases of harmful interference and request ITU assistance.

Additionally, ITU is committed to supporting efforts within its mandate towards the implementation of the Committee on the Peaceful Uses of Outer Space (COPUOS) 'Guidelines for the Long-Term Sustainability of Outer Space Activities' and making the space environment more sustainable. ITU's forthcoming 'Small Satellite Handbook' – prepared in response to ITU-R Resolution 68 on "improving the dissemination of knowledge concerning the applicable regulatory procedures for small satellites, including nanosatellites and picosatellites" – will inform governments and new space stakeholders about space radio services, including space debris mitigation.

The 17 November 2022 GVF-CBN 'Space Sustainability: Is it Too Late?' webinar will examine the role of industry in resolving a current situation wherein all space stakeholder initiatives at the UN, national, regional and industry levels need to be further reinforced for focused cooperation leading to an integrated and evolving global approach to a space sustainability governance, examining the efforts underway to bring better order to the still insufficiently regulated space environment. Much of the framework for ensuring space sustainability is "to be determined". Questions such as who regulates and what are the rules are currently inadequately answered.

"...The NewSpace era has seen the emergence of widely-held and deep-rooted concerns about just how unsustainable is the filling of low Earth orbit with our space junk – existing and potential future debris..."

Complicating matters over and above the use of our useful orbital space by almost innumerable commercial satellite communications and Earth observation companies is the rapidly increasing use of space by governments for development of military anti-satellite weapons programs. The debris fields resulting from the testing of such weapons has heightened the need to develop effective and realistic rules, particularly as reports of in-orbit near-collisions become frequent. The big question for the webinar will be, "Is it too late to ensure a safe and sustainable space environment?" Register for the webinar or, after the event, watch the recording by visiting <https://gvf.org/webinar/space-sustainability-is-it-too-late/>.

During the evening of the day of this webinar I will be returning from having moderated the Space Tech Expo Mobility Connectivity Conference panel 'Materializing Global Ubiquitous Coverage to Optimize Crew and Passenger Welfare, Decarbonization and Remote Maintenance' (with speakers from Eutelsat; neXat; Inmarsat; and the European Space Agency) and the Smallsats Conference panel 'Increasing Satellite Manufacturing Capabilities Through Innovation and Collaboration to Meet Market Demands' (with speakers from ThrustMe; the Manufacturing Technology Centre; Space Inventor; Wind River Systems; and Hemeria). For more about Space Tech Expo Europe 2022, visit <https://gvf.org/event/space-tech-expo-europe-2/>.

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Structure of the Space Insurance Market

Rotoiti, a space consulting firm, interviewed several spectrum management experts. This brief summarizes the complexities of securing spectrum authorization and the need to plan accordingly. The process described below is general; in practice, details vary depending on the satellite system.

The term “space insurance” often refers to first-party insurance that covers pre-launch, launch, initial operations in orbit, and longer lifetimes in orbit. There are two main reasons why space firms buy insurance. The first is for “refund” purposes – it allows them to recover costs that led up to an accident, repay financiers, and exit a business entirely. The second is for “reflight” purposes – it recovers costs associated with a particular mission and allows the firm to try again. Buying insurance entails understanding what costs are covered and the likelihood of an accident. Based on this, insurers charge a “premium” to provide coverage – essentially a percentage of the total amount they will pay customers if an accident occurs.

- Insurers want to know a great level of detail about the insured systems, including any modifications made to those systems when preparing for launch (as often happens); they do not tolerate “overinsuring”, which incentivizes accidents, or “underinsuring”, which allows firms to pay less in premiums than they

otherwise would. Payout disputes can arise over whether a system’s details were accurately represented to insurers.

- It is also worth noting that there are other costs associated with buying insurance besides premiums. One notable example relates to the extensive exchange of technical information that insurers often require: space firms must stand up



compliance programs to ensure the information exchanges do not violate relevant export controls regulations.

- “Pre-launch” insurance essentially regards transporting and handling cargo, and insurers in other industries often provide this. In later stages, though, insurance is provided by insurers who specialize in space. The most typical space in-

urance coverage is a package deal, comprising launch coverage plus coverage for the first year in orbit; this is because the greatest risk of on-orbit failure for satellites occurs during their first year in orbit.

“Space insurance” also often refers to third-party liability insurance, a major impetus for which is governments’ responsibility for objects launched to space. Besides

insuring themselves against accidents, space firms also buy insurance to pay for damages they may cause others – someone affected by falling debris, for instance. Under international law, governments are responsible for damages resulting from space activities occurring under their jurisdiction. Governments therefore often require firms to buy third-party insurance, because doing so minimizes possible government expenses. Insurance requirements are often capped at a certain value, after which point governments take on responsibility for paying damages.

- Governments cap insurance

requirements at certain amounts so insurance does not become prohibitively expensive to space firms and stifle industry growth. Governments try to strike a balance between requiring firms to be responsible for some payments, but not so many payments that the firms decide working in space is too costly.

Risk managers in space firms typically buy insurance via brokers, who bring risk opportunities to insurers and their underwriters. Risk managers help space firms assess how to spend resources to manage risk. They are usually responsible for buying insurance (in smaller firms, this role may fall to other employees). Risk managers typically buy insurance indirectly via brokers, who in turn compete to sell brokering services to risk managers. Brokers maintain a network of relations with insurers (the firms providing insurance). Risk managers inform the brokers they seek to buy insurance, and the brokers bring those opportunities to the insurers. Underwriters are responsible for calculating the risk and determining a premium which insurers charge; underwriters may work inside insurance firms or be contracted out.

- Though space firms are the ones buying insurance, the dynamic is often one of brokers “selling risk” to insurers – brokers try to give insurers enough understanding about and confidence in the system so they feel comfortable insuring it. Brokers typically start shopping for insurance about two years before launch.

Space insurance is a volatile market – there are relatively few insurers, and a single large accident can shrink global capacity and dramatically affect prices. There are fewer insurers for space

“...One reason why there are so few space-dedicated insurers is barriers to entry are high. Larger insurers are better able to diversify their risk holdings so that they are less likely to be overly exposed and suffer a major business catastrophe....”

than for many other industries – approximately 30 to 40 “markets” exist worldwide. Total capacity of space-dedicated insurance is estimated to be in the range of \$500 million to \$1 billion. Given that large GEO sats cost hundreds of millions of dollars, it is easy to understand why premiums fluctuate wildly; when a large loss occurs, the market quickly “hardens”, meaning there is less available insurance and premiums rise significantly.

- Another effect of the small market size is single insurers rarely provide total coverage; almost always, groups of insurers provide coverage. Brokers cobble together coverage from many insurers, trying to harmonize terms and premiums. Even if a single insurer could provide total coverage, it is unlikely to do so because it will want to diversify risk exposure over a portfolio; it will spread its exposure so that it feels confident that its collected premiums can cover an expected number of payouts it may need to make.

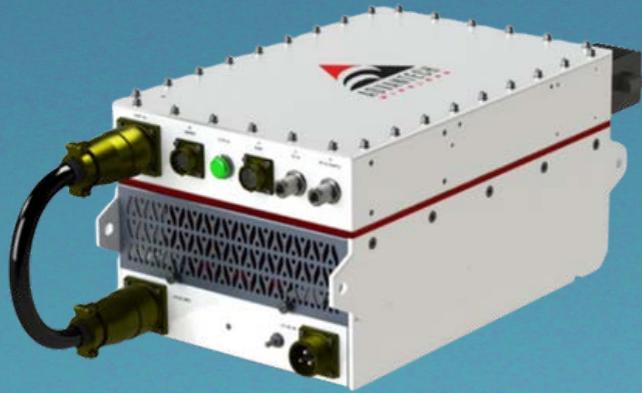
- One reason why there are so few space-dedicated insurers is barriers to entry are high. Larger insurers are better able to diversify their risk holdings so that they are less likely to be overly exposed and suffer a major business catastrophe.

- A “market” is an ambiguous

term often used by professionals in the insurance industry. It sometimes refers to one firm. At other times, it refers to a syndicate of firms. At still other times, it refers to a national community of insurers. And sometimes it refers to groups of insurers who relate to each other in some other way.

In space insurance, there is little specialization in insurance and re-insurance, given the limited size of the market. Insurers are the entities insuring space firms, whereas re-insurers are the entities insuring the insurers. In larger insurance markets serving other industries, insurance firms often specialize in either insurance or reinsurance. But this is not the case in space, due mostly to the fact that there are limited number of insurance providers. In space, rather, firms regularly switch back and forth between insurer and reinsurer roles.

- Governments sometimes impose national insurance requirements; space firms are required to buy a certain amount of insurance from local providers. This requirement may exist even if local insurers do not have enough capacity to provide insurance. In such cases, the local insurers act as the primary insurers, but they then heavily re-insure themselves with insurers in other markets.



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Space insurance has traditionally been for large GEO sats; insurers are less inclined to insure small LEO sats. Space insurance's emergence depended on the development of the GEO sat industry. GEO sats have been insurers' "bread and butter" because they are so large and expensive that operators feel compelled to insure them. But nowadays the majority of satellites being launched are going to LEO, and insurers are less inclined to insure them for three reasons: 1) LEO small sats have less heritage, which makes their risk profiles difficult to assess; 2) LEO sat operators pay smaller premiums than GEO sat operators because of LEO sats' lower value; and 3) LEO sats often belong to constellations, which makes it difficult to assess mission failure.

LEO satellite owners and operators, for their part, are less interested in insuring satellites. Constellation firms tend to "bake in" certain levels of failure into their strategies. It is common for them to launch spare satellites, for instance. Also, being in LEO means constellations experience more naturally occurring attrition as satellites fall back to Earth. Insurers have yet to devise insurance schemes for which there is widespread demand amongst LEO sat operators.

- Traditionally, sat insurance is based on assets rather than revenue. Given constellations include spares, there is little incentive to insure satellites (though asset-based insurance may develop as insurers and operators identify critical aspects of constellations which need coverage). And many constellations are still in the process of establishing revenue streams, so it is unclear what revenue-based insurance schemes

should look like.

- Constellation firms still often buy insurance for launches, though. This is because a certain amount of satellite attrition in space is built into business plans, but not the loss of several satellites at once that are being launched on the same vehicle.

A major change on the horizon for LEO space insurance relates to space debris – governments may address space debris with new insurance requirements. Space debris is a high-profile issue, so high that even people outside the space

industry are aware of it. Many governments are now contemplating imposing debris-related insurance requirements on firms. A major challenge will be determining the appropriate amount of insurance to require; it will need to be enough to protect governments from paying exorbitant amounts, but not so much that it raises the costs of operating in space and dampens growth in the space industry. 



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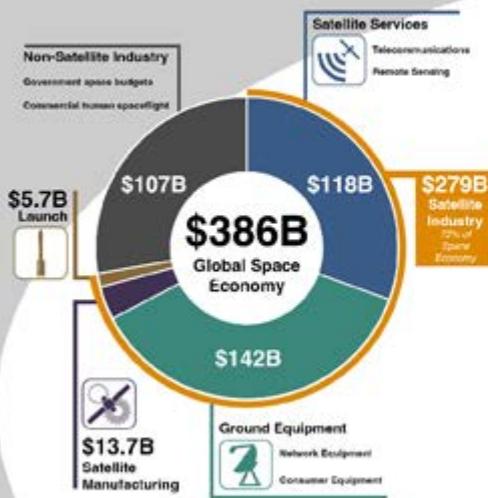
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2021 Global Satellite Industry Revenues

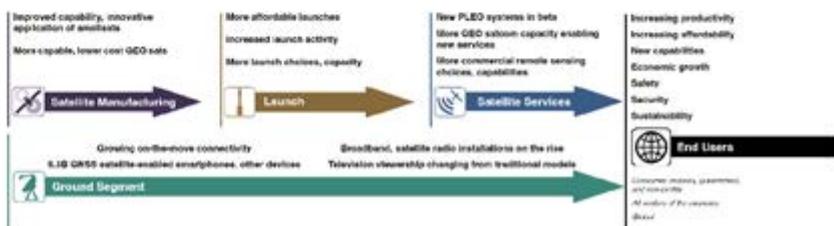
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The Satellite Industry in Context

(2021 revenues worldwide in billions of U.S. dollars)



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